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Application No: GB 0228010.5 **Examiner:** Bill Riggs
Claims searched: 1 - 10 **Date of search:** 18 June 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A		GB 1537567 A (General Motors) see whole document

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

H2A

Worldwide search of patent documents classified in the following areas of the IPC[7]:

H01R, H02K

The following online and other databases have been used in the preparation of this search report:

Online databases: EPODOC, JAPIO, WPI

1 537 567

PATENT SPECIFICATION (11) 1 537 567

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(72) Inventor CHARLES EDWARD KAYE

(19)

(54) PERMANENT MAGNET ELECTRIC MOTORS

(71) We, GENERAL MOTORS LIMITED, a British Company of High Street North, Dunstable, Bedfordshire, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to permanent magnet electric motors and more particularly to two-speed permanent magnet electric motors of the kind commonly known as "three brush" motors in which current is fed to the commutator of the motor either by a first and a second brush angularly spaced by 180°, or through the second brush and a third brush which is angularly spaced by approximately 60° from the first brush. In a high speed mode of operation of the motor the circuit is applied to the third brush and the second brush and, as only a part of the armature winding is thereby used, the motor operates at an increased speed as compared with operation with the first and second brushes in which the whole of the armature winding is used.

In the use of such motors it is found that, when the motor is first operated after manufacture, the difference in the speed between low speed and high speed operation increases as the motor becomes "run-in", so that after some hours of running the speed differential between low speed and high speed operation is more than would be indicated by test after manufacture.

According to the present invention, in a permanent magnet electric motor having diametrically opposed first and second brushes for current supply to the commutator of the motor for normal speed operation, and a third brush angularly spaced from the first and second brushes for current supply for high speed operation, the third brush is arranged so that, during an initial period of motor operation, the angular displacement between the centre of the area of contact of the third brush on the commutator and that of the nearer of the other two brushes progressively decreases.

Preferably, in accordance with this invention, the third brush of a three-brush permanent magnet electric motor is arranged so that, when initially installed, only the portion of the brush face remote from the nearer of the other two brushes (the first brush) engages the commutator. During subsequent operation of the motor the wear of the third brush on the commutator has the effect that the effective contact between the third brush and the commutator is circumferentially displaced towards said first brush until a condition is reached in which the third brush has the whole of its end face in contact with the commutator.

With this arrangement, the reduction in the angle between the centre of the area of contact of the third brush and that of the first brush effects a corresponding increase in that portion of the armature winding which will be brought into use during high speed operation, using the third brush, and this will counteract the increase in the speed of the motor during high speed operation which results from the gradually decreasing frictional loads on the motor as the parts become "run-in".

The scope of the invention is defined by the appended claims; and the invention and the method by which it is to be performed are hereinafter particularly described with reference to the accompanying drawings in which:—

Figure 1 is a part sectional end elevation of a permanent magnet electric motor according to the invention showing the arrangement of the three brushes thereof relative to the commutator;

Figure 2 is an enlarged elevation of the third brush of the motor of Figure 1, showing its position relative to the commutator surface;

Figure 3 is a plan of the brush shown in Figure 2;

Figure 4 is an end elevation of Figure 3;

Figure 5 and 6 are diagrammatic views of

the brush arrangement shown in Figure 1, respectively before and after the "running-in" of the motor; and

Figures 7 and 8 are views similar to Figures 5 and 6, but with the third brush arranged according to another embodiment of the invention.

In the first embodiment of the invention, shown in Figures 1 to 6, a permanent magnet electric motor 10, providing drive to an output shaft 11 through reduction gearing housing in a gearbox 12, has first, second and third brushes 1, 2 and 3, the first and second brushes 1, 2 being arranged in brush holders 4, 5, disposed radially of the commutator 14 of the motor 10, so as to be angularly displaced from each other on the motor commutator by 180°, and the third brush 3 being in a holder 6 which is angularly displaced from the holder 4 of the first brush 1 by approximately 60°. The end face 7 of the third brush 3 is chamfered so that, when initially installed (Figures 1 and 5) only the edge of the brush face 7 remote from the first brush 1 is in contact with the commutator 14, and the angle between the area of contact (initially substantially linear) of the third brush 3 with the commutator 14 and the effective centre of the area of contact of the first brush with the commutator is approximately 75°. During subsequent operation of the motor, the wear on the end face 7 of the thrid brush 3 brings a progressively larger area of the end face 7 into contact with the commutator 14 so that the angle between the centres of the two areas of contact of the third brush 3 and the first brush 1 progressively decreases as the wear on the third brush 3 brings more of the end face 7 of the third brush into contact with the commutator 14. After a period of operation of the motor 10 during which the motor is "run-in", the whole of the end face 7 of the third brush 3 will be in contact with the commutator 14 and the angle between the effective areas of contact of the first and third brushes 1, 3 will be substantially 60° (Figure 6). Accordingly, the progressive reduction in the speed of the motor 10 during high speed operation produced by the decreasing angle between the contact areas of the first and third brushes 1, 3 will compensate for the increase in speed which would otherwise result from the progressive reduction in the frictional load on the motor 10 as the parts become run-in.

As shown in Figures 2 to 4, the chamfer on the end face 7 of the third brush 3 preferably originates from a location near to, but spaced from the leading edge of the brush, so as to leave an adequate contact area 8, of substantially linear form, for initial engagement with the commutator 14. The brush 3 is provided with a conventional 'pig-tail' 9 for connecting the brush into th supply circuit of the motor 10.

Preferably also, the end face 7 of the third brush 3 is chamfered additionally in a plane at right angles to that of the chamfer already referred to, the inclination of this latter chamfer being less than the other, as can be seen by comparing Figures 2 and 3. It is found that this additional chamfer reduces noise caused by engagement between brush and commutator during the "running-in" of the motor.

In another embodiment of the invention shown in Figures 7 and 8, the third brush 3 has an end face similar to that of the other two brushes but the holder 6 for the third brush, instead of being aligned radially of the commutator 14, is arranged at such an angle to the commutator that, during initial operation of the motor 10 after installation of the brushes, only the edge of the third brush 3 remote from the first brush engages the commutator 14, as shown in Figure 7. With progressive wear of the third brush during the initial period of operation a progressively increasing area of the third brush comes into contact with the commutator so that the angle between the centre of the areas of contact of the first and third brushes 1, 3 with the commutator 14 progressively decreases, as in the first embodiment. Thus, the angle between the contact faces of the first and third brushes 1, 3 decreases from an initial value of approximately 75° (Figure 7) to a final value of approximately 60° (Figure 8) when the whole of the third brush end face 3 is in contact with the commutator.

WHAT WE CLAIM IS:—

1. A permanent magnet electric motor having diametrically opposed first and second brushes for current supply to the commutator of the motor for normal speed operation, and a third brush angularly spaced from the first and second brushes for current supply for high speed operation, said third brush being arranged so that, during an initial period of motor operation, the angular displacement between the centre of the area of contact of the third brush on the commutator and that of the nearer of the other two brushes progressively decreases.

2. A permanent magnet electric motor according to claim 1, in which said third brush is constructed and arranged so that, when initially installed on the motor, only the portion of the brush face remote from the nearer of the other two brushes (the first brush) engages the commutator, but, during subsequent operation of the motor, the wear of the third brush on the commutator effects a circumferential displacement, towards the first brush, of the

centre of the area of contact between said third brush and the commutator, until the whole of the end face of the third brush is in contact with the commutator.

3. A permanent magnet electric motor according to claim 1 or 2, in which the third brush is aligned radially of the commutator and the end face of the brush is chamfered so that, when initially installed, only the portion of the brush face remote from the nearer of the other two brushes (the first brush) engages the commutator.

4. A permanent magnet electric motor according to claim 1 or 2, in which said third brush is arranged so that its longitudinal axis is not normal to the surface of the commutator but at such an angle thereto that, when initially installed on the motor, only the portion of the brush face remote from the nearer of the other two brushes (the first brush) engages the commutator.

5. A permanent magnet electric motor according to claim 3 or 4, in which, when said third brush is initially installed, the angle between the centre of the area of contact of the first brush with the commutator and that of the area of contact of the third brush with the commutator is approximately 75° but during wear of the brush in the "running-in" of the motor, approaches 60°.

6. A permanent magnet electric motor constructed and adapted to operate substantially as hereinbefore particularly described with reference to and as shown in Figures 1 to 6 of the accompanying drawings.

7. A permanent magnet electric motor constructed and adapted to operate substantially as hereinbefore particularly described with reference to and as shown in Figures 7 and 8 of the accompanying drawings.

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1537567 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1.

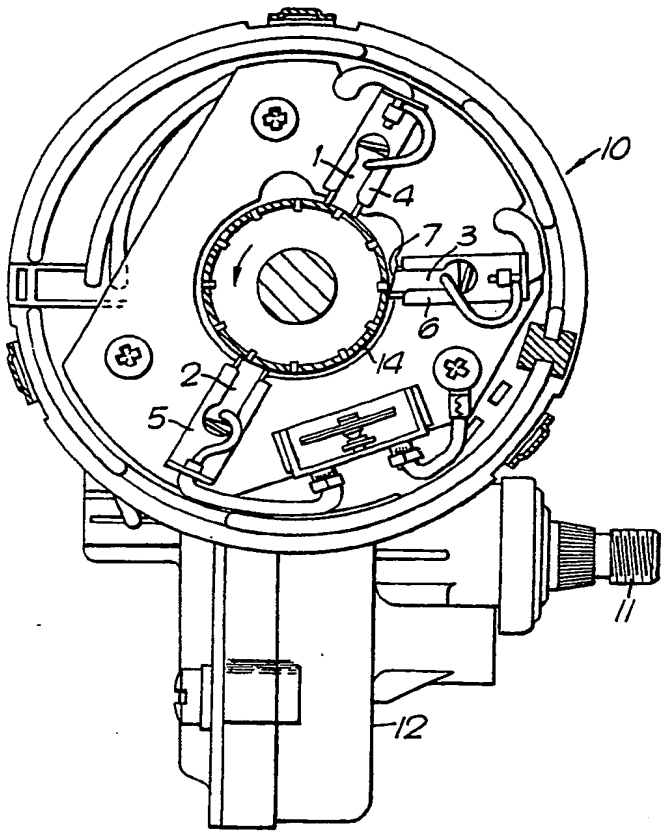

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Fig.4.

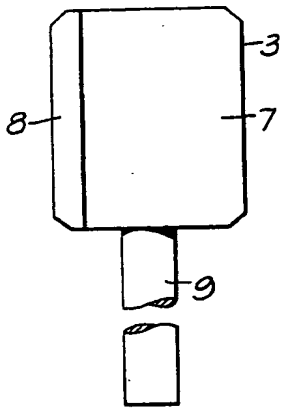


Fig.3.

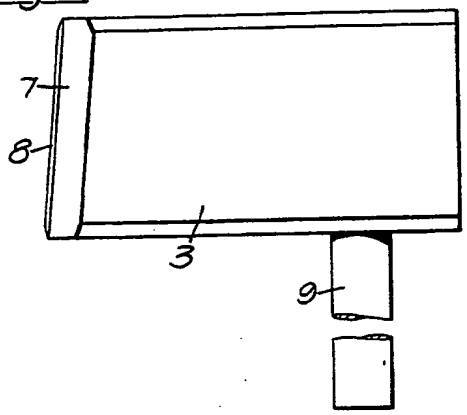
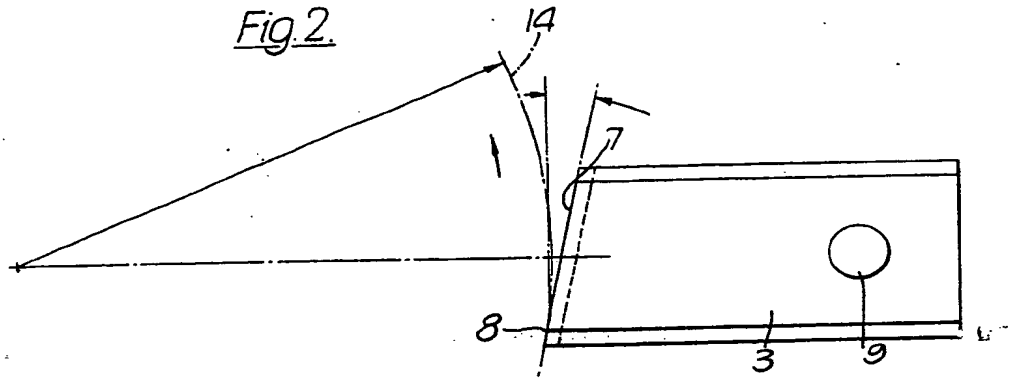


Fig.2.



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Sheet 3

Fig.5.

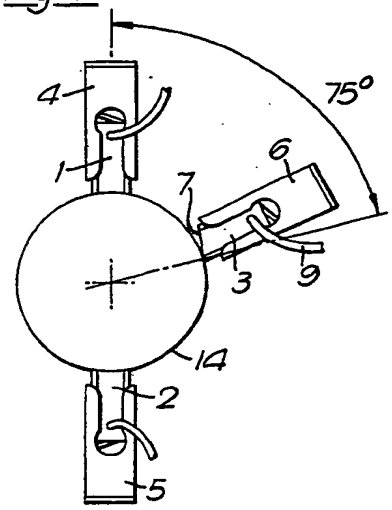

Fig.6.

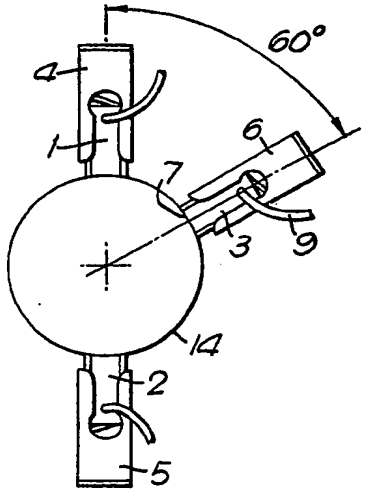

Fig.7.

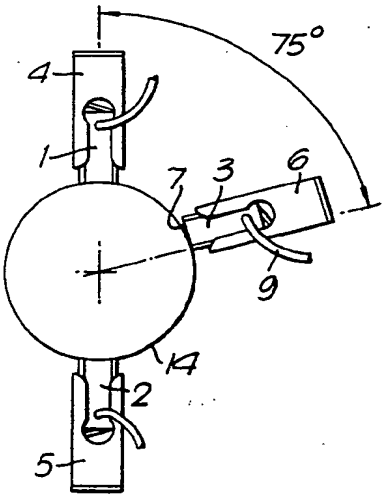

Fig.8.